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MADRAS RECORD OFFICE.

Government of Madras.

Public works DEPARTMENT.

G.O. No. 370,371,372	513	Press Mis.
Dated	17.2.	1873.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

No. 370. Read the following papers:—

From the District Engineer, Madura, to the Secretary to Government, Public Works Department, dated Camp, at Cokracolum, 2nd December 1872, No. 4,054.

I HAVE the honour to submit herewith a report, in original, from Assistant Engineer Mr. Grant, dated 29th ultimo, and received with the accompanying letter of this day's date from Executive

1 Report.
1 Letter.

Engineer Mr. J. W. Rundall, regarding the completion, *i. e.*, sufficient for traffic purposes, of the Soolochenum Bridge, Tinnevely.

2. These letters were received by me immediately prior to my handing over charge of the district to Mr. Rundall, as reported in my letter No. 4,048, of this day's date, and in forwarding them on to you, for the information of Government, I will only add such few explanatory remarks as appear to be called for in this connection.

3. I would refer you, in the first instance, to the reports I have already submitted on this subject, printed with G. O., 3rd June* 1871, and 26th January* 1872, Nos. 982 and 163, respectively, dated 9th June 1871 and 5th February 1872.

in the Revenue Department. With these and the further information now placed before you there leaves but little for me to add here.

4. In rebuilding the fallen arches it was a question with me whether to adopt the native plan of arch bonding, or that of rings as used in England. As I had had no personal experience of constructing in ring arches of so large a size as 60 feet span, and as no arch of that size has, I believe, ever hitherto been so constructed in this Presidency, I requested my friend Mr. Beresford Anderson, the Chief Engineer, Madras Railway, (with whom I had recently been officially connected in the Committee on the Cheyaur Bridge,) to favour me with his professional opinion on the subject. That gentleman informed me, in reply, that I need have no fears on the subject, whether the rings were bonded together or not.

5. I issued orders accordingly, and on hearing of the failure of the first arch, as mentioned in Mr. Grant's report, I immediately posted down to Tinnevely to investigate the cause of failure. I feel satisfied that the failure was occasioned by undue haste, both in construction and uncentring. One course of rings had been piled over another so fast as to prevent the mortar from having a chance of setting, and while the whole mass of brick-work was still green, the centring was lowered and the arch failed as described by Mr. Grant.

6. To prevent a recurrence of any such mishap, I drew up a specification of the manner in which the arches were to be constructed and uncentred. A copy is enclosed* for your information.

* Will follow. From this you will see that it was decided, among other points, to bond the rings together. The result has certainly been remarkably satisfactory. And the bridge is to be publicly opened to traffic this evening with great ceremony.

7. The only other novelties of construction introduced were—

- (a.) The use of the Malabar wheel for baling.
- (b.) The use of "rotted" chunam, *i. e.*, chunam allowed to rest or "rot" for a certain number of days after it had been mixed and pounded before being ground for use.

(c.) The construction of the spandril arches in concrete in the manner suggested by Major Beckley, R. E.—*Vide* G. O., No. 1,036, dated 22nd April 1872; and,

(d.) Tarring the extrados of the arches.

8. While reporting the successful completion of the bridge (for the parapets alone remain to be constructed) it will be seen that Mr. Grant expresses his doubts as to the capability of the bridge standing uninjured the effects of such a flood as that which caused its injury in 1869. He fears that in such an eventuality the bridge "will require repairs."

9. In paragraphs 18 to 25 of my report printed with G. O., 3rd June 1871, I have expressed my views at length as to the inadequacy of the waterway of the old structure, and that the re-construction of the bridge on its old lines, although presumably correct on the score of symmetry, is not architecturally justified, as no structure can be architecturally correct which is adapted to the purposes for which it is intended. And this has been proved to be the case in the present instance.

10. The orders of Government, however, bearing to the effect that the bridge should be re-constructed on its old lines, this has accordingly been done. No pains have been spared to make the work as effective as possible. Cut-stone floorings for the arches have been added, supported, in front and rear, on wells resting on the solid, and filled with hydraulic concrete. Rock that obstructed the flow of the stream below bridge has been removed, and all that can be possibly done to render effective a faulty design has been, most conscientiously, carried out.

11. It was not possible to open out land arches as suggested in the G. O. just quoted. Moreover, it will be remembered that in the case of the Ambasamoodrum bridge, land arches have already been added to the bridge as originally designed; but that these did not succeed in preventing the partial demolition of that structure.

12. *
13. *
14. *

15. I have already, in my letter quoted in paragraph 2, prominently brought to the notice of Government the excellent services which Mr. Grant has rendered in connection with the restoration of this bridge. He has proved himself to be a most valuable executive officer, and the Government have reaped every advantage from his early training as an Engineer in England. At the same time it must not be lost sight of that he had over him, in Executive Engineer Mr. J. W. Rundall, a departmental officer of great zeal and activity, and who has kept a careful watch over every detail of the work.

16. I wish also to draw particular attention to the services of Overseer T. Soobramania Pillay. Mr. Grant in his letter, as it will be seen, acknowledges the assistance which he has derived from this Overseer, and trusts that Soobramania Pillay's claims to promotion may not be lost sight of. I have no objection, after his recent good conduct, in seconding this recommendation. And

* See my letter No. 2,636, dated 20th October 1871. I have the less hesitation in doing so inasmuch as it was by my order* that he was removed from the Imperial List

of Overseers. It will be remembered that in the Colquhoun trial this Overseer turned approver, and was instrumental in bringing Colquhoun and Ragavacharry to punishment. At the same time he admitted the commission of certain acts on his own part, which in themselves were far from creditable. For this reason I declined, viewing the generally disorganized state of the department in Tinnevely,

to allow him to remain on the Imperial List. Mr. Puckle, however, who knew all the ins and outs of the case, asked me if I had any objection to allow the Pillay to be a Local Fund Overseer. * * * And the Pillay was accordingly appointed Local Fund Overseer. It will be remembered that in Mr. Child's judgment, when sentencing the two prisoners in the case above alluded to, the Judge stated that "the first prisoner (Colquhoun) had got him (Soobramania Pillay) completely into his power and made use of him as a tool." And it must be admitted that he was a very willing tool. Should, however, the Government be pleased to listen to these recommendations now put forward in consideration of the Pillay's recent services, for which I may add he is to be presented by Mr. Puckle with a gold medal, I would venture to suggest that his former service may be allowed to count on his re-entering the department as a Taluq Overseer.

17. In paragraph 13 of my letter printed with G. O., dated 26th January 1872, No. 163, I have ventured to mention how much of the successful operations of the bridge, as carried out up to that period, was due to the unremitting attention and assistance on the part of Mr. Puckle, the Collector. The attention of that gentleman has never flagged, and it would be unbecoming in me not to acknowledge the value of the very great assistance that this department has derived from Mr. Puckle in this as in other works of the district.

18. This bridge and that at Ambasamoodrum have been remarkable instances how work can be promptly and successfully executed in this country when the head of the district gives his cordial support to this department. The subordinates of the Revenue Department become imbued with a like spirit, and the usual antagonistic feelings are not allowed to prevail. The cheerful assistance that the Tahsildar of Tinnevely, Chinnathumby Pillay, has ever been ready to give has always appeared to me a most pleasing feature in this case.

19. I regret that it is not in my power to submit a report on the completion of the Ambasamoodrum bridge, which was opened to traffic on the 31st October 1872. But the Range Officer's report has not yet reached me, as it should have done. The District Engineer of Tinnevely will no doubt, however, forward his report on that work in due course.

20. I find that I have omitted to state that when I took charge of this division, it had been decided to remove arches Nos. 5 and 10 of the Soolochenum bridge, which were considered to betray signs of weakness, so that instead of four arches and three piers there would have been six arches and five piers to be re-built. After mature consideration, however, I came to the conclusion that such a course was not necessary. The result has fully satisfied the soundness of this conclusion. And it is satisfactory to think that an expenditure of about Rupees 30,000, to say nothing of a vast amount of anxiety and labour, has thus been saved.

21. In conclusion, I am happy to be able to state that the granite slabs which commemorated "the names of those under whose auspices the structure originally came into being" have not been irretrievably lost, as I had been led to believe. They have been recovered, and have been re-fixed in their former positions. New slabs will also be put up, but as neither Mr. Puckle nor myself care to have our names inscribed thereon, the inscription decided upon is to be as follows, namely, one in English and one in Tamil:—

"Four arches of this bridge destroyed by the flood of November 1869 were re-built by public subscription in 1871-72, under the personal superintendence of Mr. J. D. Grant, C. E., Assistant Engineer, Public Works Department."

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

From J. W. RUNDALL, Esq., District Engineer, Tinnevely, to the Superintending Engineer, 8th Division, dated Palamcottah, 2nd December 1872, No. 3.

I HAVE the honour to forward herewith a report from Mr. Grant regarding the re-construction of the Soolochenum bridge. This document is sent in original, for as I know you wish it sent at once I will not delay its submission by having it copied.

1 Letter in original.

2. In my letter No. 539, dated 8th November 1871, I reported fully regarding the foundations for Piers Nos. 6, 7, 8, put down in September and October 1871. When we recommenced work again we examined as far as we could the work done before the monsoon and found every thing most satisfactory, the Soorkee mortar had set hard and the whole of the work appeared thoroughly sound.

3. Mr. Grant gives in detail the history of the re-construction of the piers and arches.

4. You are aware of our having had to remove the greater part of the first arch constructed. It was decided after consultation with you to build the arches in rings, but it was not clear to us that in large arches like these when this is done the mortar must at least be as strong as the bricks themselves, and though it is possible that if allowed to set and dry thoroughly, the mortar might in this case have become so, yet that it has not set hard was evident when we came to remove the arch. Mr. Grant explains the method of construction subsequently adopted. By this method there was never more than 6 feet of ring which was not bonded into the ring, immediately below it, nor more than 3 feet which was not bonded into either one or other of the contiguous rings, and the bond of the whole is perfect. Every endeavour was made to have the workmanship equally good. Mr. Grant or I were always one of us on the work daily.

5. The last arch sunk more than the three others, but it is not from less careful construction, but from our being obliged to hasten the striking in order to get the centres away from the river bed, and thus the greatest sinking was only about half the amount which the original arches sunk.

6. Mr. Grant, in concluding his report, does not anticipate that the bridge as now restored would be able to withstand a flood similar to that of 1866 but I would venture to remark that the bridge is now in every way better able to withstand a similar trial. In 1869 the centre piers were founded on wells which did not touch the rock and were filled not with solid concrete but with an unset semi-fluid mass of stones and rubbish; we reached the rock and have founded the piers on a very broad base of concrete and brick-work in hydraulic cement, and have ascertained that this has set into a solid mass. The construction of cut-stone floorings with a retaining wall and aprons under the four new arches, of concrete floors under the other arches, (all these floors being at a lower level than previously,) considerably adds to the stability of the bridge. The floors were constructed carefully, but I think the necessity of periodically examining them should not be lost sight of.

7. Mr. Grant notices the great constructive fault of the original bridge, and for this there was no remedy when we were ordered to re-construct the bridge in accordance with the original design. The springings of all the arches might have been 2 feet higher with the roadway the same level as at present, the arches now being loaded with 3 feet of earth at the crown.

8. In conclusion I trust that Mr. Grant's services on this work may be brought to the notice of Government; he spared no personal exertion to ensure good work, and the new arches will, I believe, be a lasting memorial of his ability and success.

From J. D. GRANT, Esq., Assistant Engineer, to the Executive Engineer, Southern Range, Tinnevely, dated Camp at Tenthoopoonthorai, 23rd November 1872, No. 12.

THE bridge-work having so nearly approached completion that it has been considered practicable to open it for public traffic on the 2nd proximo, I have the honour to report briefly on the progress made.

The work was closed for the season on the 19th October 1872, at which date the three pier foundations had reached the level of the river bed. In November I proceeded to Alleppey, and arranged for the supply of the timber required for three centrings; it being intended to complete one arch and then remove that centring to the fourth span.

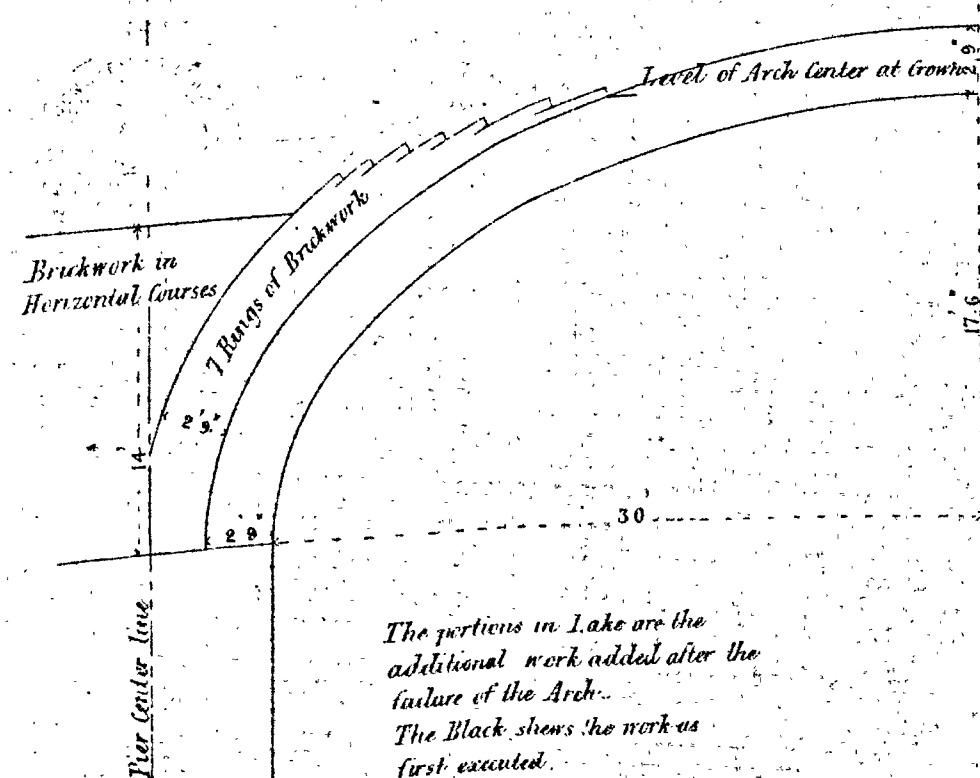
*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

In February 1872 work was recommenced and the piers rapidly carried up to the springing line, the framing of the centrings in the meantime progressing. At the end of April two centrings had been hoisted into position, a work of great difficulty, as the centrings were of the sort in use in England, in one span, without intermediate supports, and were indeed adopted from a centring actually used on a similar bridge in England.

I annex an outline of their design. In erecting the centrings the portion up to the tie-beam was fitted together on the ground between the piers and by means of derricks and capstans hoisted on the wedges. The wedges were simply wedge-shaped blocks, and in lowering the centrings were driven in by mallets. For each span five centring frames were used, and these were braced together at the king and queen posts. At the end of April two spans were centred and ready for the archwork. On the 2nd May, the first arch (No. 6 from the west bank) was begun, and a few days after the second arch was commenced and carried on slowly. The arches are 2 feet 9 inches thick, and were built in seven rings of brick-work without bonding bricks, except near the crown. The work went on steadily and the arch was closed on the 15th May. The second arch was carried up to the level of the backing of the old arches, namely, 14 feet above the springing, and the third arch carried up a few feet.

When the work reached this point it was seen that there would not be enough bricks to complete the backing of the first arch, and the second arch itself, the demand having far exceeded the supply, and as there is generally a flood in the river in the early days of June there was a chance that the removal of the centrings to the fourth arch might be indefinitely delayed, and the working season lost. It was therefore determined to allow the arch ten days to dry, and after that time to lower the centrings. While the arch was in course of construction the heat of the weather was intense, and at the end of the ten days the arch had every appearance of being thoroughly dry.

The backing having been built to the height of 14 feet above the springing line, solid, and above that level rings of brick-work tapering to a point, at the level of the centre of the arch at the crown having been added, it was arranged to strike the centrings 1½ inches or 2 inches on the evening of the 25th May.



The portions in Lake are the additional work added after the failure of the Arch.
The Black shows the work as first executed.

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

(The sketch on the opposite page shows the height of backing as built at first, the red lines show the additional backing ordered after the failure of the arch, and the plan followed throughout the work.)

On the 23th May the centring was lowered 2 inches and next day an additional inch. The crown of the arch was then found to have sunk $1\frac{1}{2}$ inches, and so far the arch appeared sound but for a slight crack, a few feet long, between two of the rings.

The centring was then lowered a little daily, but cracks between the rings appeared in all directions, and finally the arch became so much distorted that nothing remained but to pull it down and rebuild it. As only 10 or 12 feet at the crown was resting on the centring, the remainder of the arch being from 2 to 7 inches clear, it was a matter of some difficulty to remove the arch without running the risk of the arch breaking its back and destroying the centring. To obviate this risk, the space between the centring and the arch was packed up lightly with bricks in clay, and the arch then removed ring by ring.

Arrangements were now made for the supply of a fourth set of centrings.

It is difficult to arrive at the exact cause of the failure of this arch, but no doubt sufficient time was not allowed to elapse before striking the centrings.

There was evidently, too, but little cohesion between the rings, and in the arches now completed a bonding course has been introduced wherever raking joint occurs, thin bricks ($6\frac{1}{2}$ " being used to prevent too many headers being required, an occasional course of these thin bricks, breaking joint, and preventing a raking joint falling when without their use one would have occurred. A change was also introduced into the method of preparing the mortar for the archwork. In the arch which failed the proportion of lime to sand was 1 to $1\frac{1}{2}$. This was mixed, well-beaten and ground in a mill, then ground by hand on stones and at once used.

In the re-construction of the arch and in the three other arches, mortar prepared in the method commonly in use here was tried.

The proportion of lime and sand being the same, the mixture is pounded and ground as before and then thrown into a small masonry basin. Here it is left for ten days or so, covered 1 inch deep with water, and after the lapse of that time taken out, ground by hand, and used.

After undergoing this treatment it was found that the small unslaked particles, seen in the mortar previously used, were in great measure got rid of, and the tenacity of the mortar sensibly increased.

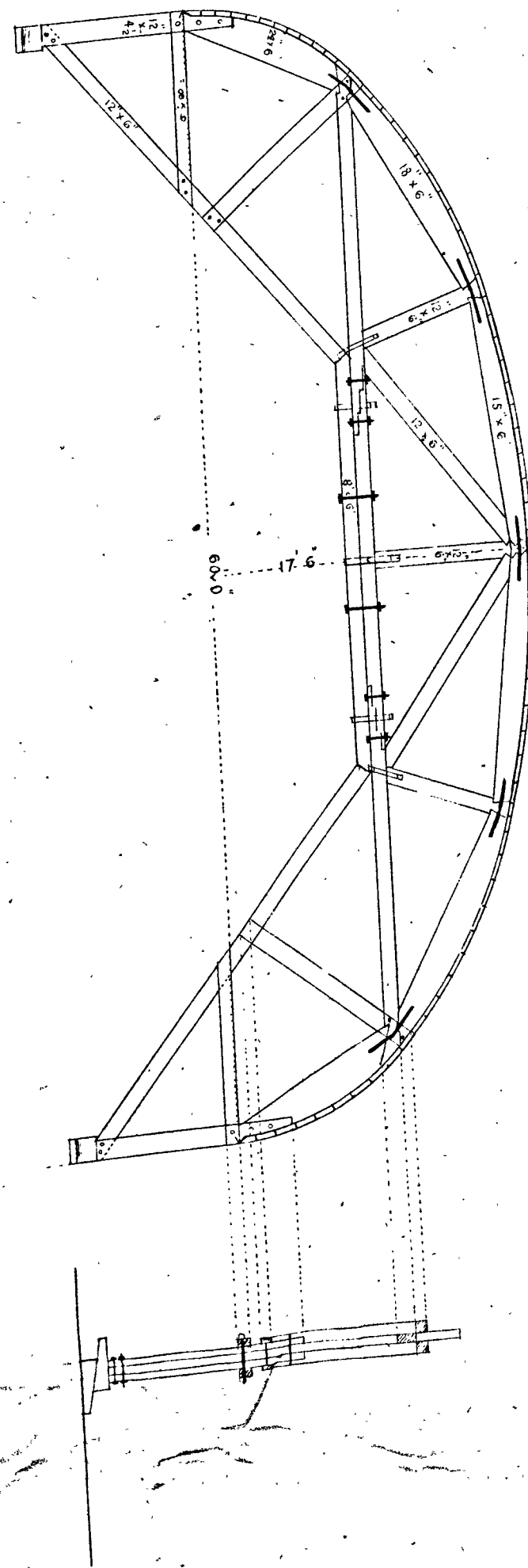
From the appearance of the arch that collapsed, it seemed as though the backing were insufficient, notwithstanding that the original height in the old bridge was used; orders were therefore given by the Superintending Engineer to raise the backing to a height of 17 feet.

In this way the four arches were completed and uncenced on the dates given in the following list:—

No.	DATE ON WHICH THE ARCH WAS			No of inches sank.	No of days building.	Time allowed to dry.
	Begun.	Finished.	Uncenced.			
1	10th June ...	28th July ...	26th August.	$1\frac{1}{2}$		
2	5th May ...	2nd August.	2nd Sept. ...	$1\frac{1}{2}$	48	29 days.
3	20th May ...	31st do.	25th do.	$1\frac{1}{2}$	89	31 "
4	12th July ...	24th Sept....	12th Oct. ...	$2\frac{1}{2}$	102	25 "
					74	18 "

In uncencing, the arches were first eased down half an inch and then left a week, after which half an inch was lowered daily till the centring was clear of the arch. Immediately on the arch standing completely unsupported the centrings were removed, a task of but little less difficulty than raising them into position.

In the spandrels there are semi-circular transverse arches of 6 feet span, the first of which was constructed immediately on the first and second arch being uncenced.



*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

These arches were built of concrete 18 inches thick, the concrete being composed of three parts of brick broken to $1\frac{1}{2}$ inches cubes and one of mortar (in the proportion of one of lime to one and a half of sand).

The centring used was of timber, the lagging planks being closely fitted. To construct one of these arches, 21 feet long, one day was required if the materials were heaped close at hand. They were allowed a week to dry and were then carefully lowered, sand boxes being used to prevent jarring. They did not, it is needless to say, sink when the centring was removed.

The last of these arches was completed on the 1st November.

Before entirely removing the centring of the main arches the soffits of three of them were plastered for two-thirds of the distance from the crown downwards, the portion of the centring up to the tie-beam being left standing as a scaffolding for this purpose.

The monsoon being at hand it was not safe to attempt plastering the fourth arch.

The extrados of the arches were then tarred, and the roadway put down.

The quantity of earth required for the roadway being very great, it would have cost a large sum to carry earth from the river bed up the banks and along the bridge; a scaffolding was therefore erected from the centre arch of the bridge leading by an inclined plane to the river bed, and by this way the earth was carried for the roadway.

The mounds of earth and kunkur excavated from the foundations were thus in some degree got rid of.

On completing the earthwork the road surface was formed and this has been completed for a week past.

The ornamental work of the parapets and the plastering alone remain to be executed next year. As a temporary measure the pilasters of the parapet (which are built) have been connected by planks forming a sort of paling, and wheel traffic may safely be passed over the bridge at any time.

The expenditure up to date has been Rupees 68,500, but most of the centring timbers and many tools remain to be disposed of.

I regret that I am unable to give the exact cost of each part of the work; but in the hurry of closing up the works the many accounts (the work being executed by daily labour) have not been classified and the abstracts made.

The report I now submit should have been deferred till the bridge was entirely finished, but as the bridge is about to be opened for traffic nothing of importance remains incomplete.

The river bed has been cleared and the old openings deepened and floored, and indeed everything possible has been done to strengthen the old work and give stability to the new. Notwithstanding all precautions, I do not entertain hopes of the bridge standing any great number of years.

Should history repeat itself, and a flood like that of 1869 again come down the river, I fear the bridge will require repairs. The bridge is low, great headway having originally been lost by placing one yard of earth over the crowns of the arches; had 1 foot 6 inches been used, the springings might have been raised 1 foot 6 inches higher and the waterway materially increased.

No land arches can be opened as the banks rise up sharply at the abutments.

Above the bridge there are several muntapums which turn the current of the river across to the east side under the tenth and eleventh arches.

The foundations of Pier No. 9 were carefully examined and repaired as well as could be where required, the new cut-stone flooring is also a great protection.

This pier and the next to it (8th) are the points where the rush of the water is greatest, and these are the piers which, in the event of a great flood, will, I anticipate, give the first warning of danger should any arise.

My connection with this bridge being now at a close, it is but just that I should say something in behalf of Overseer Soobramania Pillay, and acknowledge the assistance he has afforded me in the work.

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

To supervise the construction of arches of the size of those now completed does not fall to the lot of many Overseers of this department.

Soobramania Pillay has aided me most intelligently, and anything novel that had to be done he most speedily picked up. As a man cannot spend one and a half years on a work of this sort without gaining some practical knowledge and being a better and more efficient officer, I trust that Soobramania Pillay's claims to promotion may not be lost sight of.

No. 371. Endorsement of the District Engineer, Madura, dated Madura, 13th December 1872, No. 4,091.

No. 1,075.

Notes on the re-construction of the Soolochenum Bridge by the Superintending Engineer of the 8th Division.

The attention of the Executive Engineer, Southern Range, Tinnovely, is requested to the following notes on the re-construction of the Soolochenum bridge.

The failure of the arch appears to be due to many causes, one of which may have been the too hurried striking of the wedges, without allowing the mass of masonry sufficient time to consolidate.

2. The arch appears also to have been built layer upon layer, i. e., ring upon ring, without giving the under and inner rings the opportunity to set, so that when the arch was removed the chunam was still quite green.

3. The striking of the arches appears also to have been unequally carried out, and more care in this respect might possibly have been attended with happier effects.

4. There is also a doubt as to whether the backing of the contiguous arch under erection was carried up sufficiently high to resist the thrust of the arch when uncentred.

5. There is a doubt also whether if the "rotted" chunam had been used, it would not have held firm and dried sufficiently to allow the arch to settle properly.

6. There are other doubts in regard to the elasticity and vibration of the centring, and the consequent shaking off the voussoir joints.

7. The undersigned is not prepared to say that the whole of these doubts represent *bona fide* weak points of construction. But one fact is clear and that is that the arch failed, and it is the duty of the department not to omit any precaution to prevent the repetition of such a catastrophe.

8. With this view the Superintending Engineer desires that the following arrangements may be adhered to as closely as circumstances will permit—

(a.) All bricks to soak one entire day in water, to be taken out at night so as to be ready for use the next morning.

(b.) The chunam used to be rotted chunam, i. e., chunam pounded up, then ground and left from not less than four or more than ten days to 'rot,' the proportion of sand to lime not to exceed 1½ to 1 for the arch-work.

(c.) The arch to be built in rings, with bricks set as headers wherever a raking joint comes, so as to tie each ring to the one immediately above it. Great care to be taken in breaking bond with the rings transversely and longitudinally. Each ring is to have its farthest length of 6 feet exposed for one day previous to being topped by its covering ring. The centres to be struck, in each case, one month, or not less than 20 days, after keying.

(d.) The height of the backing of the arches, which was 14 feet in the old bridge, to be raised to 17 feet.

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

(e.) Spandril arches of 3 feet radius, and 1½ feet thick, to be built of concrete, and the space between the spandril and the main arches to be filled in with brick rubbish.

(f.) The parapet to be of the old pattern, but in lieu of the fender stones a fender course of 6" x 6" to be laid the whole length of the bridge.

(g.) The piers to be plastered with chunam up to the string course, and above that to be pointed with finely prepared chunam.

(h.) A lamp-post to be fixed one on every pier, on alternative sides, i. e., ten in all.

(i.) Rain-water spouts to have gargoyle heads; instructions will follow.

(j.) The old memorial slabs to be set as before, one on either side, with an inscription added as thus:—

* Four Arches breached 1869.

Restored in 1872.

* The inscription was subsequently modified, as reported.

(Signed)

R. A. ROBERTS, Lieut.-Colonel, R.E.,
Superintending Engineer, 8th Division.

FORWARDED to the Secretary to Government in continuation of this office letter No. 4,054, dated 6th instant.

(Signed)

R. A. ROBERTS, Lieut.-Colonel, R.E.,
District Engineer, Madura.

No. 372.

ORDER THEREON, 17th February 1873, No. 513.

CIVIL WORKS, No. 19.

ORDERED that the letter and report forwarded with the above be communicated to the Revenue Department.

2. It is observed that the work actually carried out in the restoration of the Soolochenum bridge was the re-construction of four arches and three piers. Of these, one arch had to be taken down and rebuilt in consequence of its uncentring having been commenced on the tenth day after its completion, which was on the thirteenth day from its commencement. It is also noted that the subsidence of the fourth arch which was seventy-four days in building, and was uncentred eighteen days after, was more than double that of any of the other arches which were a greater or less time under construction, but were allowed an average of one month to settle. These facts lead to the conclusion that hasty construction and uncentring of arches are to be avoided; and District Engineers are enjoined not to hurry either operation more than is necessary, in the construction of large bridges, to secure them from being endangered by floods while in an unfinished state. It is observed that the Inspecting Engineer for Buildings is strongly of opinion that the "fall of the Vellaur bridge was due to the reckless way in which it was hurried to completion."

3. Mr Grant's report is a very workman-like paper, and His Excellency the Governor in Council trusts that the work to which it relates will long remain a memorial of his ability and industry. The pains taken by Lieutenant-Colonel Roberts, R.E., and Mr. J. W. Randall in supervising and watching the details of the

*Proceedings of the Madras Government, Public Works Department,
17th February 1873.*

work are highly appreciated by the Government; and the cordial co-operation of the Revenue and Public Works officials is noticed with especial satisfaction.

4. The re-entertainment of Soobramania Pillay as a Taluq Overseer of the 3rd Grade, on occurrence of a vacancy is sanctioned.

(True Extract.)

Colonel, R.E.,
Secretary to Government.

To the Revenue Department.
" District Engineers, Madura and Tinnevely.
To all other District Engineers.
To the Inspecting Engineer for Buildings.
" " " for Ports and Communications.

Erd. S. T. Austin.

N^o 1075.

Superint^g Engineer's Office
Madura 12th June 1872.

The attention of the Executive Engineer Southern Range Tinnevely, is requested to the following Notes on the reconstruction of the Soolechenam Bridge.

The failure of the arch appears to be due to many causes one of which may have been the too-hurried striking of the Wedges, without allowing the stones of masonry sufficient time to consolidate.

2. The arch appears also to have been built layer upon layer, i.e. ring upon ring, without giving the under and inner rings the opportunity to set, so that when the arch was removed the chimney was still quite green.

3. The striking of the arches appears also to have been unequally carried out, and more care in this respect might possibly have been attended with happier effects.

4. There is also a doubt as to

whether the backing of the contiguous arch under erection was carried up sufficiently high to resist the thrust of the arch when uncentered. —

5. There is a doubt also whether if the "rotted" chumams had been used, it would not have held firm and dried sufficiently to allow the arch to settle properly. —

6. There are other doubts in regard to the elasticity and vibrations of the centering, and the consequent shaking of the voussoir joints. —

7. The undersigned is not prepared to say that the whole of these doubts represent bonafide weak points of construction. But one fact is clear, and that is that the arch failed, and it is the duty of the Department not to omit any precaution to prevent the repetition of such a Catastrophe. —

8. With this view the Superintending

23
Engineer desires that the following arrangements may be adhered to as closely as circumstances will permit. —

a. All bricks to soak one entire day in water to be taken out at night, so as to be ready for use the next morning. —

b. The chumam used to be rotted chumam, i.e. chumam pounded up, then ground and left for not less than 4 or more than 10 days to rot, the proportion of sand to lime not to exceed $\frac{1}{4}$ to 1 for the arch work. —

c. The arch to be built in rings, $\frac{1}{2}$ with bricks set as headers wherever a raking joint comes, so as to tie each ring to the one immediately above it. Great care to be taken in breaking bond with the rings transversely and longitudinally. Each ring is to have its farthest length of 6 feet exposed for one day previous to being topped by its covering ring. The arch to be struck, in each case, one month, not less than 20 days, after keying. —

d. The height of the backing of the arches which was 14 feet in the old bridge to be raised to 17 feet.

e. Spandril arches of 8 feet radius, and $1\frac{1}{2}$ feet thick, to be built of concrete, and the space between the spandril and the main arches to be filled in with brick rubbish.

f. The parapet to be of the old pattern; but in lieu of the fender stones, a fender course of 6" x 6" to be laid the whole length of the bridge.

g. The piers to be plastered with chunam up to the string course, and above that to be pointed with finely prepared chunam.

h. A lamp-post to be fixed on or every pier, on alternative sides, &c. 10 in. alt.

i. Rain-water spouts to have gurgale heads, instructions will follow.

j. The old Memorial Slabs to be set as before, one on either side, with

an inscription added as thus.—
4. Arches breached 1869.

Restored in 1872.

Signature (P. A. Roberts) ¹⁸⁷²
Superint. Engineer

This inscription
was subsequently
modified, as reported.

(True copy)

12/4/72 Forwarded to the Secretary to
Government in continuation of this office.
Letter of 12/4/72 dated 6th instant.

Madras 7
13th December 1872

Signature (P. A. Roberts) ¹⁸⁷²
District Engineer, Madras

P. H. Dept.

No 513

Proceedings of the Madras Government
Under date the December 1872.
Read the following

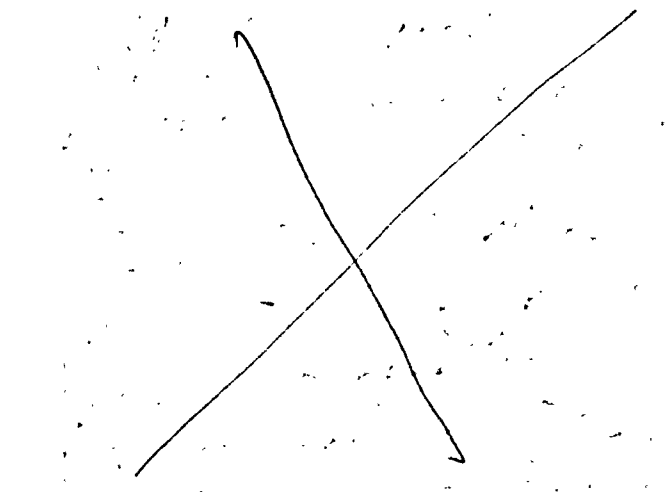
From the District Engineer
Madras

20 20

Here enter No 40546/2 Dec
here enter No 4094 17/12 1872

Ordered that
the letter and report for-
warded with the above
be communicated to the
Revenue Department.

It is observed
that the work actually
carried out in the restora-
tion of the Soolochernum
Bridge was the recons-
truction of 4 Arched
and



It is observed that the work actually carried out in the restoration of the Soolochernum Bridge was the reconstruction of 4 Arched and

1872
The District Engineer
Madras

20
The District Engineer
Madras

Date 15th December
1872

Summary for information
copy of the letter of
Colonel Roberts to the
Superintendent of the
Soolochernum Bridge.

No 513-17 20th Dec 1872

Dec 31

and 3 Piers. Of these,
one Arch had to be taken
down and rebuilt, in
consequence of its uncer-
tering having been com-
menced on the 10th day,
after its completion, which
was on the 13th day from
its commencement. It is
also noted that the subsi-
dence of the 1st Arch which
was 7 1/2 days in building,
and was uncentered 18 days
after, was more than
double that of any of the
other Arches which were
a greater or less time
under construction, but
were allowed an average
of one month to settle.

The question of readjusting
the whole of the bridge
Pillars - should also
be dealt with - I think
it might be done and
will
11/7

219
These facts lead to the
conclusion that hasty
construction and uncer-
tering of Archwork to
be avoided; and Dis-
trict Engineers are
enjoined not to hurry
either operation more
than is necessary, in
the construction of large
bridges, to secure them
from being endangered
by floods while in an
unfinished state. It
is observed that the
Inspecting Engineer
for Buildings is strong-
ly of opinion that the
"fall of the Vellore Bridge"
was due to the reckless
way

*
Dr. Mr. J. C. Lee
recd. of L. Col
Robertson's re-
port - 11/11

way in which it was
hurried to completion.

Mr. Grant's Report
is a very workmanlike
paper, and His Excellency
the Governor in Council
trusts that the work to
which it relates will long
remain a memorial of
his ability and industry.

Y.M.W.

The pains taken
by Lieut Colonel Roberts
R.E. and Mr. J. W. Stincaill
in supervising and watching
details of the
the work are highly apprecia-
ted by the Government;
and the cordial cooperation
of the Revenue and Public
Works Officials is noticed
with

with especial satisfaction.

139
The re-entertain-
ment of Subbramaniam
Pillay as a Talook Over-
-seer of the 3^d Grade, on
occurrence of a vacancy
is sanctioned.

Y.M.W.

to The Rev. Deptt
" D. S. Supremadurai & Tinnavelly
all other D. S. Engineers
" The Insp. of Engrs. for Buildings
" " " for P. & Comm.
" Controller of Engrs.

Decr 5/3/72

C/26174 & 6295
★

Govt. of 1873 Madras.

PUBLIC WORKS.

To The Revenue Dept.

Date 3-

Recd.

Encl. 2

G. O. 17th Feb 1873. No. 5103.

No. 370 @ 372

Revenue Notice.

intention on the
of from the 18th Aug
in the restoration
of the bridge.